

Exhibit B

Randall W. Dick ¹

A SUMMARY OF HEAD AND NECK INJURIES IN COLLEGIATE ATHLETICS
USING THE NCAA INJURY SURVEILLANCE SYSTEM.

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ABSTRACT: The NCAA Injury Surveillance System (ISS) was used to evaluate head and neck injuries in twelve intercollegiate sports for 3-6 years through the 1990 season. Sports were categorized as those with and without mandated head protection. Prevalence of head and neck injuries were expressed as both a percentage of all reported injuries in a specific sport (%) as well as an injury rate (IR). In addition the primary injury mechanism was noted. Concussions were also listed as a percentage of all reported injuries in a sport and as an injury rate. Of the sports with no head protection, field hockey, men's soccer and women's soccer had the highest prevalence of head injuries and concussions expressed as both % or IR. Ice hockey and football had the highest head injury values of the sports with head protection. Wrestling and football showed the highest % and IR for neck injury.

KEYWORDS: head injury, neck injury, concussion, intercollegiate athletics, NCAA Injury Surveillance System

Head and neck injuries in football have received increased attention in the last few years with most of the literature focusing on those injuries that result in permanent brain damage, quadriplegia or fatalities in the sport of football (1,2,3). However, head and neck injuries are not unique to football and many of these injuries, while serious in nature, are not severe enough to be classified as catastrophic. Systems currently exist that monitor the catastrophic head and neck injuries in football (4,5) and multiple sports (5). Less attention however, has been devoted to monitoring the prevalence of less severe head and neck injuries, such as concussions, in a variety of sports. The purpose of this study is to review head and neck injuries in twelve intercollegiate sports using data collected from the NCAA Injury Surveillance System (ISS).

¹ Assistant Director of Sports Sciences, National Collegiate Athletics Association, 6201 College Boulevard, Overland Park, Kansas 66211.

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METHODS

The NCAA Injury Surveillance System (ISS)

The ISS was developed in 1982 to provide current and reliable data on injury trends in intercollegiate athletics. Injury data are collected annually from a representative sample of NCAA member institutions in sixteen sports, and the resulting data summaries are reviewed by the NCAA Committee on Competitive Safeguards and Medical Aspects of Sports. The committee's goal continues to be to reduce injury rates through suggested changes in rules, protective equipment or coaching techniques based on data provided by the ISS.

Sampling

Participation in the ISS is voluntary and limited to the 847 member institutions (as of September 1991). ISS participants are selected from the population of institutions sponsoring a given sport. Selections are random within the constraints of having a minimum 10 percent representation of each NCAA division (I, II, and III) and region (East, South, Midwest, West).

It is important to emphasize that this system does not identify every injury that occurs at NCAA institutions in a particular sport. Rather, it collects a sampling that is representative of a national cross-section of NCAA institutions.

Data Reporting

Injury and exposure data are recorded by certified and student athletics trainers from participating institutions. Information is collected from the first official day of preseason practice to the final tournament contest.

Injury Definition

A reportable injury in the NCAA Injury Surveillance System is defined as one that:

1. Occurs as a result of participation in an organized intercollegiate practice or game;
2. Requires medical attention by a team athletics trainer or physician, and
3. Results in any restriction of the student-athlete's athletics participation or performance for one or more days beyond the day of injury.

Each injury is described in detail including body part injured, type of injury, injury mechanism, severity, field condition and special equipment worn.

Exposure Definition

An athlete exposure (A-E), the unit of risk in the ISS, is defined as one athlete participating in one practice or game where he or she is exposed to the possibility of athletic injury.

Injury Rate Definition

An injury rate (IR) is a ratio of the number of injuries in a particular category to the number of athlete exposures in that category. In the ISS, this value is expressed as injuries per 1,000 athlete exposures.

Concussion Definition

In this study, concussion was defined as a traumatically induced alteration in mental state with confusion or amnesia common, and loss of consciousness in Grade 3 (6,7).

RESULTSHead and Neck

Head and neck injuries from practices and games were reviewed for a three to six year period (1984-1990) for twelve intercollegiate sports. Values are expressed as a percentage of all reported injuries (%) and as injuries per 1000 A-E (IR). The primary injury mechanism for head injuries is also reported. It should be noted that eyes, ears, nose, face, chin, jaw, mouth, teeth, and tongue are separate ISS body part categories and are distinct from the head. In other words, head injuries as defined in this study, do not include injuries to the body parts mentioned above. Information from seven collegiate sports with no mandatory head protection is shown in Table 1. Table 2 shows the same information for five collegiate sports that require head protection.

TABLE 1--Head and neck injuries - sports with no head protection

Sport	Head		Neck		Primary Injury Mechanism
	(%)	(IR)	(%)	(IR)	
Field Hockey	4.5	(0.23)	1.0	(0.05)	Contact w. stick
Women's Lacrosse	4.1	(0.17)	0.7	(0.03)	Contact w. ball
Men's Soccer	4.0	(0.31)	0.4	(0.03)	Contact w. player
Women's Soccer	3.7	(0.29)	1.0	(0.08)	Contact w. player
Women Basketball	3.1	(0.16)	0.9	(0.05)	Contact w. player
Men's Basketball	2.5	(0.14)	0.8	(0.04)	Contact w. player
Wrestling	2.9	(0.28)	5.4	(0.51)	Contact w. player

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TABLE 2--Head and neck injuries - sports with head protection

Sport	Head		Neck		Primary Injury Mechanism
	(%)	(IR)	(%)	(IR)	
Ice Hockey	5.4	(0.30)	1.7	(0.09)	Contact w. player
Football	4.5	(0.29)	4.2	(0.28)	Contact w. player
Men's Lacrosse	3.2	(0.22)	1.7	(0.12)	Contact w. player
Women's Softball	2.9	(0.11)	1.6	(0.06)	Contact w. ball (non-pitch)
Baseball	2.8	(0.09)	0.3	(0.01)	Contact w. ball (non-pitch)

Head Injuries -- Data indicate that ice hockey had the highest percentage of head injuries of the sports monitored (5.4%), followed by football and field hockey (4.5%), women's lacrosse (4.1%) and men's soccer (4.0%). Injury rates in sports with no head protection such as men's soccer, women's soccer and field hockey were comparable to the helmeted sports of ice hockey, football and men's lacrosse, respectively.

Neck Injuries -- Wrestling had almost double the neck injury rate (0.51) as football (0.28) and more than four times higher than that of men's lacrosse (0.12). Neck injury rates in the nine remaining sports were significantly lower than these three activities. Most of the neck injuries were muscle-tendon strains.

Head Injury Mechanism -- Player contact was the primary injury mechanism for all but four sports monitored. Contact with the stick was the primary head injury mechanism in field hockey while contact with the ball was the chief mechanism in women's lacrosse. Contact with a non-pitched ball was the primary head injury mechanism in both softball and baseball.

Concussions

Concussions, a subset of head injuries, are listed as a percentage of all reported injuries (%) and as injuries per 1000 A-E (IR) for sports with mandatory head protection (Table 3) and sports with no required head protection (Table 4). Concussions accounted for at least 60% of head injuries in each of the sports monitored.

TABLE 3--Concussions - sports with no head protection

Sport	Concussion	
	(%)	(IR)
Women's Lacrosse	3.9	(0.16)
Field Hockey	3.8	(0.20)
Men's Soccer	3.2	(0.25)
Women Basketball	3.0	(0.15)
Women's Soccer	2.8	(0.24)
Men's Basketball	2.1	(0.12)
Wrestling	1.8	(0.20)

TABLE 4--Concussions - sports with head protection

Sport	Concussion	
	(%)	(IR)
Ice Hockey	4.5 %	(0.25)
Football	4.1 %	(0.27)
Men's Lacrosse	3.0 %	(0.19)
Women's Softball	2.9 %	(0.11)
Baseball	2.1 %	(0.07)

DISCUSSION

This study has shown that head and neck injuries are not unique to the sport of football. Ice hockey, wrestling, and soccer have been shown to exhibit head injury rates rivaling those of football, while men's lacrosse and field hockey have rates of slightly smaller magnitude. Most of these injuries are not catastrophic in nature. Neck injuries are less frequent except in the sports of wrestling and football.

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The activities analyzed in this study were grouped by whether they required head protection. Both categories included similar ranges of head injury data, expressed either as a percentage of all injuries or as an injury rate. This finding should not be interpreted as questioning the efficacy of head protection; most would agree that protective helmets reduce head injuries in the sports in which they are worn. Instead, these data present a baseline that can be used to evaluate effectiveness of future rules or equipment changes in the monitored sports. For example, the effectiveness of a mandatory helmet rule in women's lacrosse could be monitored by comparing injury data collected following the rule implementation with the data reported here.

With regard to injury mechanism, it is interesting to note that player contact was the primary cause of head injuries in the "non-contact" sports of basketball and soccer. Such injuries may be best controlled by a more stringent enforcement of playing rules by game officials. The ball and the stick were the primary cause of head injuries in women's lacrosse and field hockey, respectively. Such mechanisms may not be as easily controlled by playing rules. Interestingly, these sports have been opposed to the introduction of head protection (8). In baseball and softball, contact with a non-pitched ball was the primary head injury mechanism. This category translates into errantly thrown balls by fielders or contact with a batted ball. Prevention may include better field maintenance and an evaluation of ball liveliness.

Concussion make up the majority of head injuries in the twelve sports examined. With the recent focus on multiple impact syndrome, an evaluation of concussions may be a first step in the prevention of severe injuries (7). Without protective headgear, the rate of concussions in sports requiring this equipment would be even higher.

Mouth guards have also been shown to be an effective means of prevention of concussions in sport (9). Currently mouth guards are required in the sports of NCAA ice hockey, football, men's lacrosse, women's lacrosse and field hockey. Mouth guards are also worn by many men's and women's soccer and basketball players, although they are not currently mandatory equipment in these sports.

In summary, non-catastrophic head injuries have been shown to account for three to five percent of the injuries in twelve intercollegiate sports while neck injuries were much less frequent. Concussions made up the bulk of the reported head injuries. Medical personnel should be educated on the diagnosis and treatment of such injuries in all sports and rules protecting the head and neck should be enforced. The rules against butting, ramming and spearing are for the protection of both the player initiating the blow as well as the receiver of the blow. A player who does not comply with these rules in any sport is a candidate for a serious head or neck injury.

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